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Coles County Solid Waste Management System Analysis

Roy F. Weston, Inc., West Chester, PA

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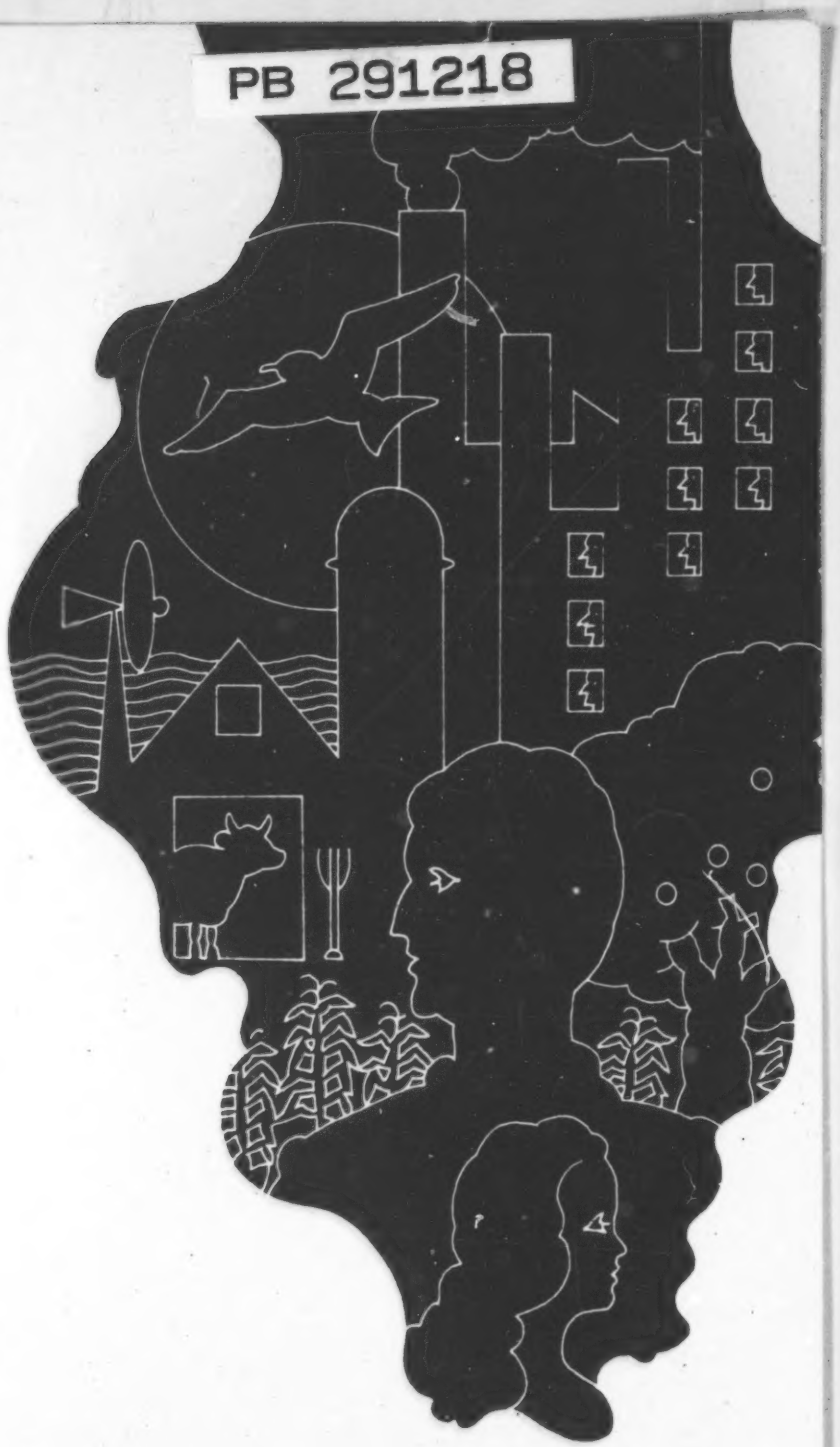

COLES COUNTY
SOLID WASTE MANAGEMENT SYSTEM ANALYSIS

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Roy F. Weston, Inc.

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The Need for Advance Planning in Illinois

In July, 1970, the Illinois General Assembly passed the Illinois Environmental Protection Act. This law expresses the determination of the people to improve the quality of the environment in Illinois. The Act addresses problems of air, water, land and noise pollution.

In 1973, the Illinois Pollution Control Board adopted new regulations for sanitary landfills. These regulations are enforced by the Illinois Environmental Protection Agency. The permit and inspection provisions established under these regulations are among the most comprehensive and vigorous in the United States. Each landfill operator is required to apply for a permit by April 27, 1974. The expense of meeting Illinois design and operating standards has and probably will cause some marginal landfill operations to close, thereby eliminating some environmentally unacceptable, but convenient, disposal sites.

The dwindling number of solid waste disposal sites has caused concern among municipal officials and private solid waste companies. Efforts to aquire new sites have often been thwarted by citizens who recognize the need for such facilities, but would rather see them located somewhere else.

The increased costs associated with everything these days have strained municipal budgets. Solid waste management is a large budget item. Elected officials are asking: Can this be reduced?

Over half of the solid waste in Illinois is managed by private companies. Their costs are increasing, and so are the rates charged to their clients. Public officials are asking: What is the cost of solid waste management? Should we go into business for ourselves?

In 1973, the energy crisis reinforced the long-standing argument by

environmentalists that something should be done to recover the resources going into solid waste. Solid waste managers now must cope with the added complexities of unproven recovery systems and an uncertain market for recovered commodities.

These and other pressing problems require planning. This study provides a basis for that planning by examining the economics of current solid waste management practices and proposed regional management strategies.

State Solid Waste Plan

The State Solid Waste Management Planning Project will examine the solid waste needs of Illinois and make recommendations as to actions that can be taken by the State to improve solid waste management generally. The Solid Waste Management Task Force of the Illinois Institute for Environmental Quality recognized from the start that solid waste management is a local responsibility and is subject to the specific desires of the people as to the services desired and the manner of satisfying these desires. Consequently, the task force suggested that the principal thrust of the State planning project should be to assist the work of local and regional planners who must prepare the specific recommendations for local officials.

This report is an analysis by the State and its consultants of several alternatives available to a specific region. Basic data used in the analysis was gathered by the regional planners, processed by the consultants, and rechecked by the regional planners. Elsewhere in the State plan, the planner will find reference data on the natural features of the State which will have an impact on solid waste management activities.

The Analytical Process

People and their activities produce solid waste. The first step in the planning procedure was to determine population and employment. Basic population projection data was generated by Argonne National Laboratory using historic census data and a predictive model. These projections were checked by the regional planner using local data and projections by the Illinois Office of Planning and Analysis (OPA). Tables 1 and 3 show examples of population and employment projections. Employment data was taken from the

Table 1

PROJECTED POPULATION EXAMPLE

LOCATION	1970	1975	1980	1985	1990	1995	2000
City A	305	305	350	360	390	400	410
City B	39,992	44,500	48,500	51,400	54,000	57,100	59,800
City C	2,435	2,780	3,010	3,230	3,440	3,690	3,910
City D	26,396	27,900	34,400	39,100	43,800	49,000	54,100
SUB TOTAL	69,128	75,385	86,260	94,090	101,630	110,190	118,220
UNINCORPORATED	21,754	23,400	24,200	24,800	25,300	25,900	26,400
COUNTY TOTAL	90,882	98,785	110,460	118,890	126,930	136,090	144,620

Table 2

AN ILLUSTRATION METHOD OF MUNICIPAL SOLID WASTE GENERATION

(1) Political Subdivision	(2) 1970 Population	(3) Area, $(mi.^2)$	(4) Population Density (2) ÷ (3)	(5) Log (4)	(6) 1.54 X (5)	(7) Generation Factor (6) - 0.68 #/cap./day	(8) Collection Rate (2) x (7) #/day	(9) Collection Rate (8) ÷ 285.7 ton/week
City A	305	0.17	1,794	3.25	5.01	4.33	1,320	4.6
City B	39,992	11.37	3,517	3.55	5.46	4.78	191,161	699.
City C	2,435	1.28	1,902	3.28	5.05	4.37	10,641	37.
City D	26,396	6.06	4,356	3.64	5.60	4.92	129,868	455.
Co. Remainder	21,358	1,157.	18.7	-	-	3.4	72,617	254.

Table 3

AN EXAMPLE OF THE EMPLOYMENT PROJECTIONS

SIC	1971	1975	1980	1985	1990	1995	2000
City B 207	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2432	25	29	31	35	36	40	42
3272	3	0	0	0	0	0	0
358	1,500	2,470	2,750	3,020	3,220	3,630	4,010
City C 243	15	15	15	15	15	15	15
271	4	1	0	0	0	0	0
City D 275	15	21	27	32	37	43	49
278	60	79	100	140	170	210	240
301	225	225	225	225	225	225	225
327	32	32	35	35	35	35	35

Illinois Manufacturers' Association Directory as an historic data base. Employment projections are expressed in 3- and 4- digit Standard Industrial Classification (SIC) code (Table B-1, Appendix B).

Approved population projections are then multiplied by waste generation factors to give the municipal solid waste load (i.e. the residential and commercial wastes generated within a community).

Table 2 is an example of a tabular solution in which population is translated into a solid waste generation rate. (A more detailed explanation of the columns and the computational method is contained on Page B-1, Appendix B). Similarly, Table 4 gives a sample calculation in which employment is translated into tons of industrial wastes. The conversion factors (Table B-1, Appendix B) for converting employment data into tons of waste were derived by the consultant from data supplied by the USEPA. Table 5 shows, where there is no centrally located municipality, how the residential waste from unincorporated areas is allocated (on the basis of percentage of area) and combined with municipal and industrial wastes for the purpose of subsequent analyses. Wastes from unincorporated areas are considered to be located at the centroid of the township.

For long-term planning, consideration must be given to the annual change in generation rates. The computational methodology is shown on Table 6. A 2% and 3% per year increase in the generation factor was used for cities with more than 10,000 people and less than 10,000 people respectively.

Total waste quantities for the present (1973) and a future date (1990) are presented on Table 7. These waste quantities are, in turn, provided as input to a computerized model. The computer then determines the cost of hauling waste from the centroid of each source to each specified processing or disposal site. Transportation costs are added to site annual operating costs to determine a total annual system cost. It is within the capability of the computer model, if it is so instructed, to select the combinations of sources, processing facilities and ultimate sites which given the least (optimum) system cost.

Table 4

EXAMPLE OF INDUSTRIAL WASTE LOADING CALCULATION

(1) Location of Political Subdivision	(2) SIC Code	(3) Number of Employees in 1971	(4) Generation Factor (Ton/Empl/Yr)	(5) Production Rate (Ton/Yr) (3) x (4)	(6) Production Rate (Tons/Week) (5) ÷ 52	(7) Total Industrial Waste For Each Source (Ton/Week)
City A						0
City B	207	1,000	3.3	3,300.	63.4	
	2432	25	232.	5,800.	111.5	
	3272	9	154.	1,310	26.1	
	358	1,500	1.5	2,250	42.2	243.2
City C	243	15	21.7	3 325.5	6.3	6.3
City D	275	15	1.1	16.5	-	
	278	60	2.6	156.	3	
	301	225	3.7	833.	16	
	327	32	15.	480.	9.2	28.2

Table 5

EXAMPLE OF COMPOSITE LOADING SHEET FOR BASE YEAR - 1973

Source Name	I.D#	SIC Load (Ton/Week)	Municipal Load (Ton/Week)	Area for Division of County Remainder (Miles)^2	Load due to County Remainder (Ton/Week)	Total Load (Ton/Week)
City A	101	-	4.6	9.7	54.6	59.2
City B	102	243.2	699.	10.	56.3	998.5
City C	103	6.3	37.	10.4	58.6	101.9
City D	104	28.2	455.	15.	84.5	567.7
				45.1	253.98	
County Remainder -		-	254			1727.3

Table 6

AN EXAMPLE OF THE COMPOSITE SHEET FOR WASTE LOADS (Ton/Week) FOR 1990

Source Name	I.D.#	1990 Industrial Load (Ton/Week)	1970 Generation Rate (#/cap./day)	% Increase Per Year	Total % Increase	1990 Generation Factor (#/cap./day)	1990 Municipal Waste Loads (Ton/Week)	County Area Factor	County Remainder Based on Area (Ton/Week)	1990 Total Waste Loads (Ton/Week)
City A	101	-	4.33	3	60	6.9	9.4	36	94.3	103.7
City B	102	360	4.78	2	40	6.35	1264.	48	125.7	1389.7
City C	103	6	4.37	3	60	6.99	84.3	64	167.7	252.
City D	104	36	4.92	2	40	7.87	1207.	36	94.3	1301.3
County Remainder			3.4	3	60	5.44	482	184		3046.7

Table 7

EXAMPLE OF THE STUDY PERIOD SOURCE INVENTORY

SOURCE NAME	SOURCE ID NO.	1973 VALUES QUANTITY (Tons/Week)	1990 VALUE QUANTITY (Tons/Week)
City A	101	59.2	103.7
City B	102	998.5	1389.7
City C	103	101.9	252.
City D	104	567.7	1301.3

In addition to sources and waste quantities, the computer must be given cost parameters for transportation and for the operation of the solid waste management system specified. Unit costs for the disposal systems tend to be lower as the quantities increase. Such variable cost factors are best described by cost curves which were incorporated into the computer input. These cost curves are shown in Figs. B-1 and B-2, Appendix B.

In developing the planning factors and cost curves, the consultant was faced with the problem of picking a finite value for a given function when, in actuality, that function could be described by a range of values. The values given here are neither the highest nor the lowest, but an estimate of current conditions. They were adjusted to 1973 cost levels using the Engineering News-Record construction cost index. Where appropriate, assumptions are listed.

Computations do not include the cost of solid waste collection. It is assumed that, regardless of the management system used, the waste must be collected. Whether it is collected once a week or twice a week, at the curb or at the back door, in plastic bags or in 32 gallon cans, are matters of local preference. The alternatives addressed in this study include the cost of moving from the centroid of the collection area to an intermediate or final disposal site.

Aside from taking the drudgery out of the thousands of calculations required, the computerized model permits the planners to examine a range of management alternatives. The strategies thus examined and reported here were proposed and analyzed by the regional planner with assistance from the State's consultants.

Resource Recovery

These analyses take a conservative view of the economics of resource recovery alternatives. As of March, 1974, there were no large scale resource recovery systems operating in the United States. Certain demonstrations projects are operating successfully in Franklin, Ohio and St. Louis, Missouri. Larger systems have been designed and several are under construction. We can

predict operating and capital costs better than we can predict the off-setting revenues from the sale of recoverable resources. Table 9 gives recent prices for the secondary materials present in typical municipal waste. These prices are subject to the usual variations of the commodities market, as well as regional variations in transportation costs. Table 10 describes eight levels of resource recovery activities and the expected revenue (based on Table 9 prices). The decision to adopt a resource recovery system will entail an evaluation of the risk involved in the fluctuating market values.

Uses of This Report

The results of this analysis are intended to assist the regional planner in preparing recommendations for local decision makers. The analytical techniques used are based upon averages and generalized planning factors developed in 1973 and cannot be expected to reflect the exact local cost situation. The usefulness of this regional analysis is to show the relative economic merits of alternate management systems, thus enabling the planner to separate the most feasible alternatives from the least feasible.

This report includes basic data, planning factors, and sample calculations so that the regional planner can make specific adjustments later on. It is to be emphasized that the least cost solution is not necessarily the best. The recommended solution will be that which combines economy with regional desires and constraints. To prepare such recommendations is the task of the regional planner.

Future Planning

It is expected that regional planners will need to up-date their plans and to consider other strategies. It is the intention of the Illinois Institute for Environmental Quality to maintain the capability for providing these regional analyses.

TABLE 9

RESOURCE RECOVERY VALUE FOR FERROUS AND NONFERROUS METALS, GLASS, FIBERS AND HEAT VALUE

Materials Recovered	Conc. In MSW (%)	Recovery (%)	T /100T MSW	Delivered Price	Trans. Charge (5)	Net Credit	Credit $/Ton Of Input Solid Waste
Ferrous Metal (6)	7.5	100	7.5	$56	$ 46	$11.7	$ .82
#2 Bundle	7.5	100	7.5	20 (10-30)	6	10	0.75
Madison (3)	7.5			51	6	14	1.05
Scrap Steel Jan. 73 (4)				86	6	45	
Jan. 74 (4)						80	
Scrap Steel Incinerator Residue			7.5	12 (10-14)	5	7 (5-9)	.53 (.40-.72) (.42 (6))
Aluminum	1.0	100	1.	200	50	150	1.50
Copper Zinc Fraction	.5	100	.5	240	50	190	.95
Copper Scrap (Jan. 73) (4)				860	50	810	
(Jan. 74) (4)				1360	50	1310	
Tin Scrap (Madison (3))				4000	50	3950	
Glass (Sorted by color)	9.	44	4.	16	6	10	.40
Mixed Glass Fines	9.	70	6.3	5	6	- 1	-0.06
Fourth Forest Pulp	40. (Dry Basis)	45	18.	25	8	17	3.06
Newsprint (July 73) (4)			8	18	8	10	0.80
(Nov. 73) (4) Separated			8	35	8	27	2.16
(Jan. 74)			8	60	8	52	4.16
Paper (6)			15.			15	2.25
Energy Recovery							
Electric Energy (6)			6.67×10^4 Kwhr.			$.006/Kwhr.	4.00
Shredded Refuse Heat Value (7)			7.5×10^8 Btu/100 Ton			.50¢/M Btu	3.75
Total Combustible	75. (Wet Basis)	100	75.			(1.)	4.95
Combustible After Fiber Recovery	75. (Wet Basis)	66	50.			(2.)	3.3
Synthetic Fuel Oil (6)			4.80×10^8 Btu/Ton			$.8-/10^6$ Btu	3.36
Synthetic Fuel Gas (6)			6.7×10^8 Btu/Ton			$.50/10^6$ Btu	3.33
Steam			175				3.33
			175	1.90 @ .95/1000#			

1. Produces 450 Kilowatts-hours of Electricity/Ton, Valued at 1.1 Cent per Kilowatt-hours.
2. Producers 300 " " " " " " " " " " " " "
3. From Madison Wisconsin Shredding and Landfill Operation.
4. Wall Street Journal - January 31, 1974
5. Transport Cost for 1973 Average Used Through-out, Value Fluctuates
6. Resource Recovery - The State of Technology, pg. 25
7. Commonwealth Edison 1974

This Table summarizes the by-product credits that may be realized by reclamation of recyclable materials from a ton of MSW. The credits reflect 1973 conditions and assume reasonable transportation charges to proximate recycling plants; i.e., the credits are based on delivered prices and representative concentrations of the salvaged materials in MSW. Extreme fluctuation can be seen in a one year period. Selection of appropriate value must be based on transport distance and market demand.

Table 10

TABLE OF RESOURCE RECOVERY VALUES FOR VARIOUS SYSTEMS

A. Small operation - magnetic separation of cans
$1.05/Ton of Input Municipal Solid Waste (M.S.W.)

B. Cans and Paper Recovered
$1.05 Cans
3.06 Paper - based on separate collection
$4.11/Ton of Input M.S.W.

C. Cans, Paper, Aluminum, Copper - Zinc Fraction Recovered
$1.05 Cans
3.06 Paper - separate collection
1.50 Aluminum
.95 Copper - Zinc Fraction
$6.56/Ton of Input M.S.W.

D. Cans, Paper, Aluminum, Copper-Zinc, and Fraction Heat Recovery
$1.05/T for Cans
3.06/T for Paper separate collection
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.00/T for Heat Recovery after Fiber Recovery
$9.56/Ton M.S.W. Input

E. Incineration with Residue Recovery. Recover only Steel Cans
$ .53 Cans from incinerator Residue

$ .53/Ton M.S.W

F. Metal Recovery, Heat Recovery, Heat Recovery of Shredded M.S.W.
$1.05/T for Magnetic can separation
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.75/T for Shredded Fuel Value

$7.25/T of Input M.S.W.

G. Incineration with Residue Recovery and Heat Recovery
$ .53/T for Cans from incinerator Residue
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
4.50/T for Heat Value

$8.00/T for Heat and Material Recovery of M.S.W.

H. Source separation and separate collection of newsprint
$ .80-4.16/Ton of input Municipal Solid Waste (M.S.W.)

CAUTION: This table shows the value of recovered resources for 8 theoretical recovery systems. It is based on the "credit $/Ton" column of Table 9, and is subject to the conditions and assumptions stated. Tables 9 and 10 may need to be modified to reflect local markets and transportation costs.

Management Alternatives for Coles County

Coles County is a rural county with the two major cities of Mattoon and Charleston. The majority of the population and employment is concentrated in these two municipalities. The presence of students at Eastern Illinois University causes a seasonal variation in the quantity of solid waste generated. The refuse is collected and transported almost exclusively by private agencies to the disposal sites.

The Coles County Planning Commission identified three sites as major landfills in their county. The IEPA indicated there are seven other possible locations which have been used for waste disposal. The largest landfill is the Service Disposal site which has an operating capacity of approximately 1200 tons per week.

Present Problem

The Service Disposal site will be filled in 1976. Since it takes about two years to obtain a permit and to open a new landfill, planners and county officials realize that some decision should be made in 1974. This decision will have to consider such questions as: How many sites are needed? Where should they be located? What is the relationship between haul and disposal cost? and, What system for the county will give the lowest overall cost? This analysis is intended to provide some answers to these questions.

Computational Methods

Population and employment projections and waste loads were calculated using the methods described in Chapter 1. The results are tabulated in Tables 1, 2 and 3 of Appendix A. A summary of geological information for

Coles County, also given in Appendix A, indicates generally the soil and groundwater conditions that may influence the selection of a sanitary landfill site.

Short-term Analysis

Short-term planning solutions include those alternatives that could be reasonably expected to be operational within two to three years after regional plans are accepted. Each alternative analysis is described by a diagram which summarizes the waste sources, disposal sites, haul costs, facilities costs, and the system unit cost. Conclusions are discussed below:

Alternative 1

The existing system includes 19 waste sources and 9 landfills. The small landfill sites are convenient for private dumping, while the two major landfill sites (501, 502) handle more than 75% of the waste generated. The two large landfills operate for less than $4.00 per ton, whereas the seven smaller landfill operate at unit costs exceeding $8.00 per ton. The total system unit cost, including haul and facilities costs, is $6.99/ton. This is a reasonable cost despite the excessive number of uneconomical, small landfills. It can be expected that many of these small landfills will close after the July 27, 1974 deadline for having IEPA operating permits. With the smaller landfills closed and the largest landfills nearing completion, it is possible that a crisis situation will develop in 1974 or 1975. The next alternative should consider the possibility of deleting the smaller landfills and adding a large landfill to the present system.

COLES COUNTY

Cost Of Existing System

Alternative 1

Key:

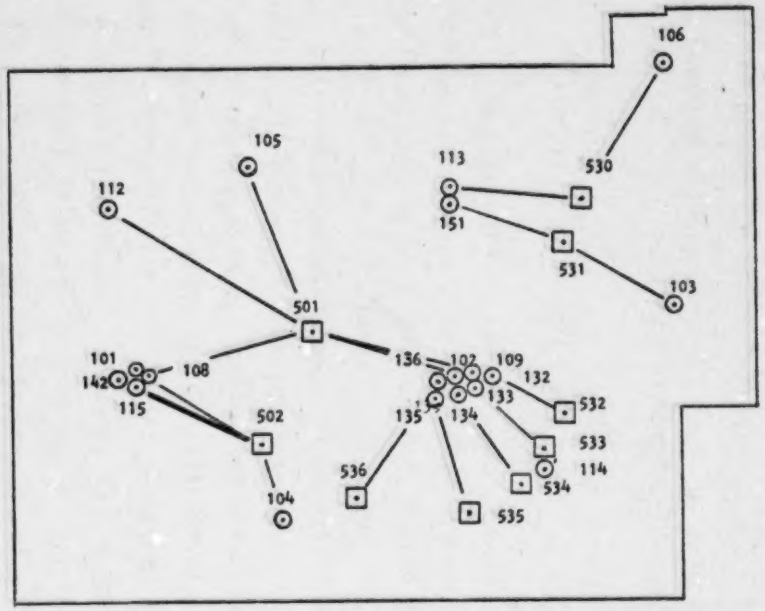
___ From Source to Ultimate

- - - From Source to Intermediate

..... From Intermediate to Ultimate

⊙ Sources

ID #	Name
101	Mattoon East
102	Charleston East
103	Ashmore
104	Lerna
105	Humbolt
106	Oakland
108	Mattoon West
109	Charleston
112	North Okaw
113	Seven Hickory
114	Hutton
115	Mattoon North
132	Charleston 1
133	Charleston 2
134	Charleston 3
135	Charleston 4
136	Charleston 5
142	Mattoon 1
151	7 Hickory 1



⊙ Intermediate Facility

ID#	Name

⊡ Ultimate Facilities - Land Fills

ID #	Name
*501	Service Disposal
*502	Young's
*530	Site 530
*531	Site 531
*532	Site 532
*533	Site 533
*534	Site 534
*535	Site 535
*536	Site 536

* Indicates Facility In Use

Summary of Existing System

1973 - 1974

General Cost Summary

Total Facility Annual Cost	$305,000
Total System Haul Cost	264,000
Total System Annual Cost	$569,000

Total System Unit Cost $6.99/Ton

Tonnage Handled 1563 Tons/Week

This summary describes an evaluation of the present system. The two major sites and seven minor sites are listed as recipients of all county generated waste. The quantities of refuse for each source are the result of waste factors generated using population and employment data. The source-site pairing and facility information provided herein represents data provided by the local planning agency and IEPA, if possible. Some sources are matched with sites by proximity.

The analysis emphasizes the following facts:

1. There are a number of dumps or landfills which would have a high unit cost if operated properly.
2. The operation of the two main landfills should be completed within 2 years.
3. The heaviest concentration of waste is in the Charleston and Mattoon areas and new sites should be located in one or both regions.
4. Haul cost are high to some areas.

General Haul Cost Assumptions

Packer Haul $4.36/Ton-Hr.

Transfer Haul $1.40/Ton-Hr.

Directions for further analysis:

1. Reduce number of small landfills which have high unit costs.
2. Use of a transfer station in the northeastern portion of the county to reduce haul costs.
3. Consider the use of processing facilities to reduce the refuse to be disposed.
4. Investigate the use of only one landfill for county-wide disposal

Alternative 2

The two-site system consists of the present Service Disposal site and a new site in the south-central portion of the county. This area has acceptable geology and it is assumed that adequate land is available. Each waste source is assumed to be delivered to the closest disposal site in an effort to minimize haul costs. Alternative 2 offers a slightly lower unit cost of operation, $6.95/ton as opposed to $6.99/ton for Alternative 1. The lower cost is the result of a $90,000 saving in facility costs (elimination of small landfills) and a $62,000 increase in haul costs. The two larger landfills could be better managed and more environmentally acceptable. The elimination of small, convenient landfills could lead to an increase in promiscuous dumping if measures are not taken to provide some equally convenient service.

Alternative 3

If a new landfill is opened, as described in Alternative 2, the next question is: what will happen when the Service Disposal landfill is closed within the next 3-5 years? Alternative 3 evaluates the single, South-Central landfill as the ultimate disposal site for the entire county. The results indicate an even trade-off between decreased facility cost and an increased haul cost. The total system unit cost of $6.61/ton unit is essentially the same as the $6.59/ton cost in Alternative 2. The major advantage of the single landfill is the opportunity for better management. Disadvantages include: the lack of an alternate disposal site for use in the event of a work stoppage, for whatever cause, and the lack of competition among site operators. The total land requirements for the 17-year period (1973-1190) would be approximately 140 acres (assuming a 20-foot depth of fill).

COLES COUNTY

The Use Of The Service Disposal (501) And The South Central Facility (601) In An Optimized System.

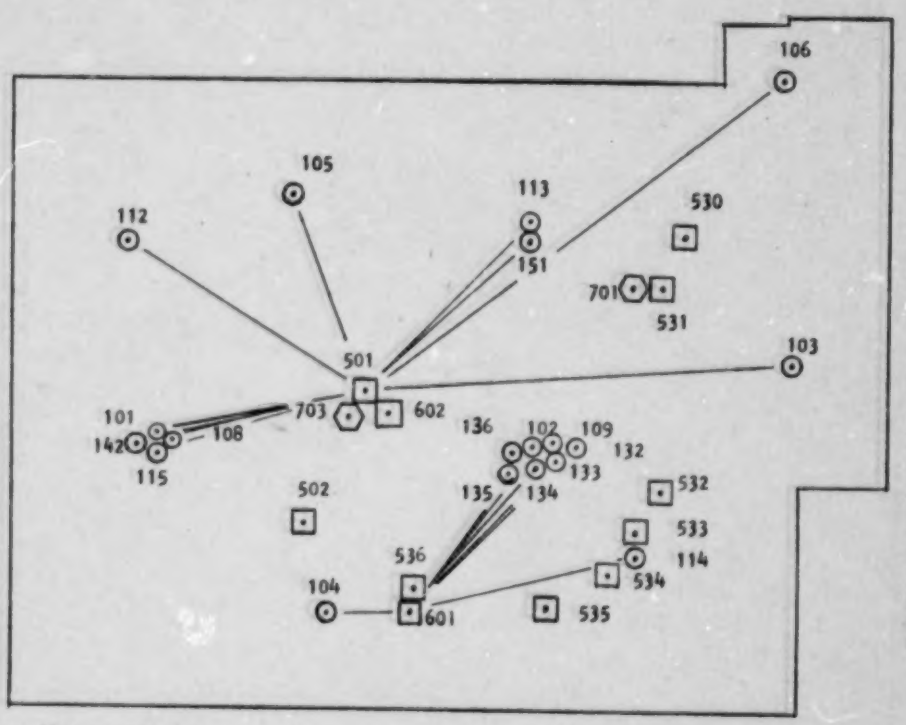
Alternative 2

Key:

____ From Source to Ultimate

- - - From Source to Intermediate

..... From Intermediate to Ultimate



Sources

ID #	Name
101	Mattoon East
102	Charleston East
103	Ashmore
104	Lerna
105	Humbolt
106	Oakland
108	Mattoon West
109	Charleston
112	North Okaw
113	Seven Hickory
114	Hutton
115	Mattoon North
132	Charleston 1
133	Charleston 2
134	Charleston 3
135	Charleston 4
136	Charleston 5
142	Mattoon 1
151	7 Hickory 1

Intermediate Facilities

ID#	Name
701	Site 531 Transfer
703	Central Resource Recovery

Ultimate Facilities - Land Fills

ID#	Name
501	Service Disposal
502	Young's
530	Site 530
531	Site 531
532	Site 532
533	Site 533
534	Site 534
535	Site 535
536	Site 536
601	New South Central
602	New Replace 501 Site

s Indicates Facility In Use

General Haul Cost Assumptions

Packer Haul Cost $4.36/Ton-Hr.
Transfer Haul Cost $1.40/Ton-Hr.

General Cost Analysis

Total Facility Annual Cost $216,000
Total System Haul Cost 320,000
Total System Annual Cost $536,000

Total System Unit Cost $6.59/Ton
Tonnage Handled 1563 Tons/Week

COLES COUNTY

New Landfill (601) Located East Of Lerna In South Central Area As Indicated By The Planning Commission To Dispose Of All Waste From The County.

Alternative 3-

Key:

____ From Source to Ultimate

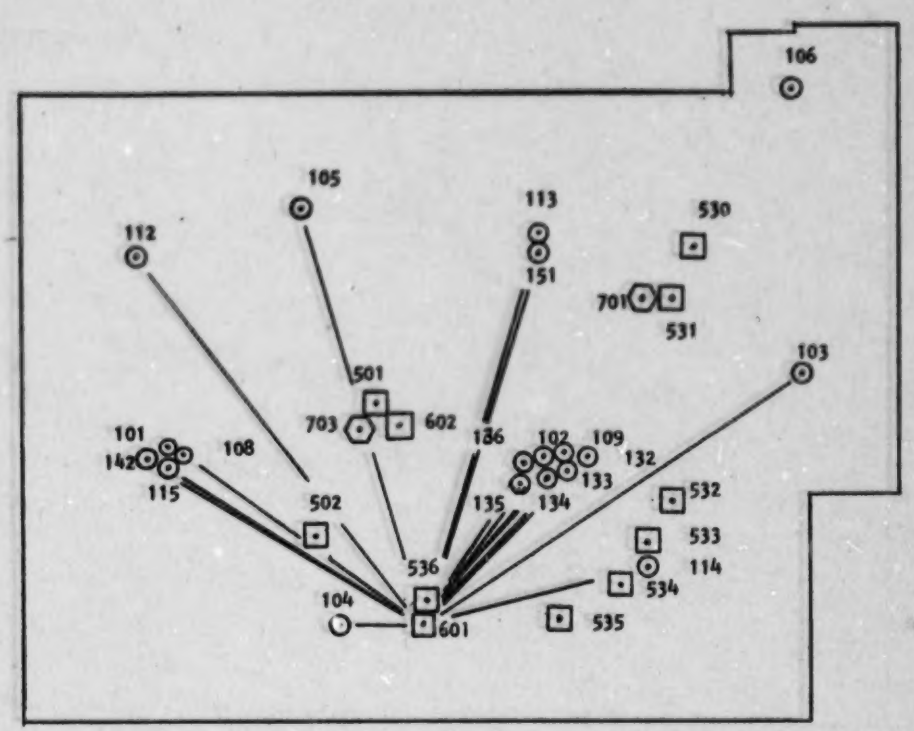
- - - From Source to Intermediate

..... From Intermediate to Ultimate

N

⊙ Sources

ID #	Name
101	Mattoon East
102	Charleston East
103	Ashmore
104	Lerna
105	Humbolt
106	Oakland
108	Mattoon West
109	Charleston
112	North Okaw
113	Seven Hickory
114	Hutton
115	Mattoon North
132	Charleston 1
133	Charleston 2
134	Charleston 3
135	Charleston 4
136	Charleston 5
142	Mattoon 1
151	7 Hickory 1



⊙ Intermediate Facilities

ID#	Name
701	Site 531 Transfer
703	Central Resource Recovery

⊡ Ultimate Facilities - Land Fills

ID#	Name
501	Service Disposal
502	Young's
530	Site 530
531	Site 531
532	Site 532
533	Site 533
534	Site 534
535	Site 535
536	Site 536
*601	New South Central
602	New Replace 501 Site

* Indicates Facility In Use

General Haul Costs

Packer Haul Cost $4.36/Ton-Hr.
Transfer Haul Cost $1.40/Ton-Hr.

General Cost Analysis

Total Facility Annual Cost	$166,000
Total System Haul Cost	371,000
Total System Annual Cost	$359,000
Total System Unit Cost	6.61/Ton
Tonnage Handled	1563 Tons/Week

COLES COUNTY

The Use Of A Resource Recovery Facility 703 Near The Present 501 Site To Handle All County Waste With Residue To The New 602 Site.

Alternative 4

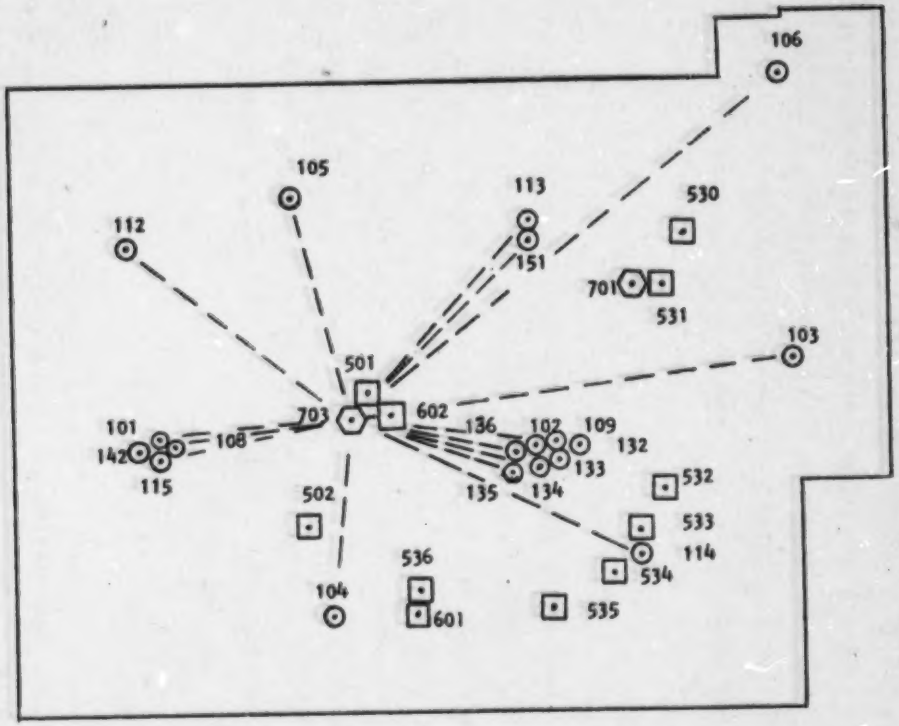
Key:

___ From Source to Ultimate

- - - From Source to Intermediate

..... From Intermediate to Ultimate

N



Sources

ID #	Name
101	Mattoon East
102	Charleston East
103	Ashmore
104	Lerna
105	Humbolt
106	Oakland
108	Mattoon West
109	Charleston
112	North Okaw
113	Seven Hickory
114	Hutton
115	Mattoon North
132	Charleston 1
133	Charleston 2
134	Charleston 3
135	Charleston 4
136	Charleston 5
142	Mattoon 1
151	7 Hickory 1

Intermediate Facilities

ID#	Name
701	Site 531 Transfer
*703	Central Resource Recovery

Ultimate Facilities - Land Fills

ID#	Name
501	Service Disposal
502	Young's
530	Site 530
531	Site 531
532	Site 532
533	Site 533
534	Site 534
535	Site 535
536	Site 536
601	New South Central
*602	New Replace 501 Site

* Indicates Facility In Use

General Haul Costs

Packer Haul Cost $4.36/Ton-Hr.
Transfer Haul Cost $1.40/Ton-Hr.

General Cost Analysis

Total Facility Annual Cost $1,189,200
Total System Haul Cost 277,835

Total System Annual Cost $1,467,000
Total System Annual Unit Cost $18.04/Ton
Tonnage Handled 1564 Tons/Week to Resource Recovery
391 Tons/Week to Landfill

Alternative 4

Alternative 4 examines the possibilities of resource recovery for Coles County. The minimum sized plant would cost about $2.6 million for a rated capacity of 500-700 tons/day. Unfortunately, Coles County has only about one-half this amount and the total system unit cost of $18.04/ton is greatly in excess of current disposal cost and the potential value of recoverable materials. It is possible that plants may become less costly and that the market for secondary materials will increase, at which time the County potential should be re-evaluated.

Summary

Sufficient land areas are apparently available for the continued use of landfills in Coles County. A single, centrally-located landfill appears to be the most attractive alternative. However, there is no significant increase in the cost of a two-landfill system if fills can be located so as to reduce haul distances. The relatively low costs of these alternatives is attributed to the central location of present and proposed landfills. It does not appear that resource recovery will be feasible until processing costs can be reduced and the market value of recoverable materials increases.

Use of this Study

The use of the information contained in these studies is complicated by the inability of the public to identify with some of the cost assumptions used and the cost of the existing system.

As for cost assumptions, the study uses a 5-year amortization schedule for trucks and equipment. Drivers and operators are paid a union wage. If actual local costs are known, the regional planning official can adjust

the totals, however this is not especially important because the real usefulness of the cost analyses is to show the difference between alternatives.

The cost of the existing system can be difficult to explain to the rural resident who has no solid waste collection service and therefore pays nothing. It is important that he recognize that it is the rural landowner who generally pays for an inadequate solid waste management system by promiscuous dumping that take place on his land or along the roads which serve his property. The aggravation, the possible land devaluation, and the legal liabilities of having an open dump on his property are real costs to the landowner. The road maintenance funds spent on trash pickup have been estimated by one study at $50 per ton. The diversion of road funds can only result in less road maintenance, which is a further cost and inconvenience to the rural landowners. In any case, part of the rural property tax dollar will be used for the disposal of solid waste. The officials of Cole County have met this problem wisely and are providing a "green box" container service which is available to rural residents on one-weekend per month schedule.

This study is intended for elected officials, directors of public works, regional planners, and private solid waste operators - all of whom must work together to find acceptable solutions to regional waste problems. Much of this information presented here is subject to change. Planners and engineers who have need to up-date or modify these alternatives may obtain assistance from the Illinois Institute for Environmental Quality.

APPENDIX A

COLES COUNTY INFORMATION

		PAGE
1	Geological Information	A-1
2	Population Projections - Table A-1	A-2
3	Employment Projections - Table A-2	A-3
4	Solid Waste Quantities by Source Table A-3	A-4
5	Crisis and Decision Dates - Table A-4	A-5

GEOLOGICAL INFORMATION
COLES

Type of Bedrock: Mainly shale with some water-yielding sandstone and limestone.

Drift Thickness: 50 to 200 ft. of drift except some small areas of less than 50 ft. in south portion.

Type of Drift Material: Till covers entire county with 4 ft. of loess.

Glacial Aquifers: Possibly present.

Sand and Gravel Aquifers: Scattered.

Limestone Aquifers: Absent.

Sandstone Aquifers: Possibly present.

Coles County bedrock is composed of mainly shale with some water yielding sandstone and limestone. Two buried bedrock valleys are found in this county, one parallel with and east of the Embarass River and the other going west from the Mattoon area. The Wisconsinan glacier reached over most of the county depositing 50 to 200 ft. of drift over most areas. The drift material is till with a 4 ft. layer of loess. The sand and gravel aquifers are scattered over the county with the exception of the Embarass River Valley. The sandstone aquifers are present, but no known limestone aquifers are of concern.

The potential for bedrock contamination is moderate in the thin drift areas of the south and the very northeast corner, but the remainder of the county should have adequate drift thickness. Unconsolidated aquifer contamination is moderately possible in the Embarass River Valley.

TABLE A-1

PROJECTED POPULATION FOR

COLES COUNTY

LOCATION INCORPORATED	1970*	1975	1980	1985	1990	1995	2000
Ashmore	428	430	430	440	450	460	470
Charleston	16,421	16,500	18,000	19,900	21,800	28,700	25,700
Humboldt	366	360	380	390	410	430	450
Lerna	288	290	290	290	300	300	310
Mattoon	19,681	20,900	21,900	23,100	24,400	25,700	27,000
Oakland	1,012	950	940	950	960	960	960
SUB TOTAL	38,196	39,500	42,000	45,200	48,400	51,700	54,900
UNINCORPORATED	9,619	9,730	9,490	9,370	9,250	9,120	8,960
COUNTY TOTAL **	47,815	49,300	51,500	54,600	57,700	60,800	63,900

* Census Data Report PC(V1) 15 January 1971

** Summations performed prior to rounding off

TABLE A-2

Coles County

PROJECTED EMPLOYMENT FOR

CHARLESTON

SIC	1971	1975	1980	1985	1990	1995	2000
2421	8	7	7	6	5	6	6
271	35	62	91	120	150	180	220
275	228	280	350	420	480	550	620
307	45	66	89	110	130	150	180
314	400	350	300	270	230	200	180
3272	3	2	2	2	2	2	2
328	3	2	2	2	2	2	2
329	30	76	120	170	220	270	320
3321	75	72	72	66	67	67	67
344	83	66	63	62	67	72	77
359	3	1	1	0	0	0	0
371	450	570	750	900	1020	1120	1210
394	4	5	7	9	11	13	15

MATTOON

203	40	28	20	16	10	7	6
204	44	43	42	42	41	41	39
208	72	79	90	99	99	100	120
209	20	19	19	19	19	18	18
233	227	220	250	280	310	330	360
264	50	73	95	100	140	150	170
271	51	67	78	94	100	110	120
275	493	850	1230	1720	2160	2590	3010
314	68	67	65	64	62	60	61
323	5	4	4	4	4	4	4
324	98	170	230	300	360	430	490
3321	70	67	67	62	62	62	62
335	160	160	170	190	200	210	210
344	50	64	76	87	100	110	130
348	146	120	120	99	96	84	75
352	5	4	0	0	0	0	0
355	120	160	220	270	310	370	410
356	500	490	470	470	470	470	470
359	10	11	14	16	19	21	23
361	20	26	35	43	50	59	65
362	1012	1270	1490	1710	1930	2140	2360
371	290	440	680	950	1240	1550	1870
399	2	1	1	1	1	1	1

ASHMORE

204	3	2	2	2	2	2	2
287	12	12	13	14	15	16	17

TABLE A-2 Continued

DECATUR

SIC	1971	1975	1980	1985	1990	1995	2000
371	460	480	410	360	310	270	240
381	150	140	130	130	140	140	150
382	50	80	110	140	170	200	230
385	5	5	5	5	5	5	5
386	80	130	190	260	310	390	440
393	30	22	13	8	5	3	1
394	150	150	140	150	140	130	140
399	52	61	68	76	83	90	96
FORSYTH							
251	10	10	10	10	10	10	10
HARRISTOWN							
204	5	5	5	5	5	5	5
353	10	10	10	10	10	10	10
MACON							
209	5	0	0	0	0	0	0
275	30	35	40	45	50	54	57
MAROA							
251	2	6	7	10	13	14	15
MOUNT ZION							
251	3	8	12	19	20	22	24
321	450	530	610	710	810	910	990
3272	5	4	4	5	5	5	5
354	10	6	2	0	0	0	0
OREANA							
209	10	9	10	10	10	10	10

TABLE A-4

CRISIS AND DECISION DATES FOR VARIOUS ALTERNATIVES FOR COLES COUNTY

Alternative 1: All fills used to completion. A new fill would be needed or an existing fill expanded to compensate for the loss of a number of small fills.

Fill Sites:	501	502	530	531	532	533	534	535	536
Crisis Date:	1976.8	1977.5	1974	1974	1974	1974	1974	1974	1974
Decision Date:	1974.8	1975.5	Now	Now	Now	Now	Now	Now	Now

Alternatives 2: Use of a centrally located site 602 near the present site 501 for all county waste. The ultimate fill capacity would need to be about 1.6 million cubic yards to supply disposal areas for 17 years.

Fill Site:	602
Start-Up Date:	1976
Crisis Date:	1993
Decision Date:	1991

Alternative 3: Use of a new landfill 601 developed for operation beginning in 1976 with an ultimate capacity of 1.6 million cubic yards. This site would be located near site 536 in the south-central portion of the county.

Fill Site ID#:	601
Start-Up Date:	1976
Crisis Date:	1993
Decision Date:	1991

TABLE A-4
(Continued)

Alternative 4: A new landfill must accompany any new processing facility as the present fill sites will be completed at virtually the same time as a new facility would become operational. Use 501 and 502 to completion in 1976. At this point in time, new facilities such as recycling, shredding or composting, could be operational, but a new fill would be required for residue assuming a 10 year lifetime for the new landfill, the following dates are:

	Composting and Resource Recovery % Reduction			Incineration % Reduction
	25%	50%	75%	85%
Lifetime of New Landfill (Yr.):	13	20	40	53
Crisis Date:	1989	1996	2016	2029
Decision Date:	1987	1994	2014	2027

APPENDIX B

Planning Factors

	Pages
1. Method for calculating municipal and industrial collection rates.	B-1
2. Industrial waste generation factors. Table B-1	B-3
3. Haul Cost Factor with assumptions. Table B-2	B-6
4. Cost Functions: Sanitary Landfill. Figure B-1	B-9
5. Basic Landfill Cost Assumptions For 50, 100, 250, 500, 1000, 2000, and 5000 tons/week. Tables B-3 to B-9	B-10
6. Cost Functions: Intermediate Processing Facilities. Figure B-2	B-18
7. Equations for Facility Cost Functions.	B-19
8. Resource Recovery Facility Description.	B-21
9. Resource Recovery Capital and Annual Cost. Table B-10	B-22

Municipal Generation Rates

The technique selected for estimating present generation rates was developed by Roy F. Weston, Inc. The technique involved the calculation of a generation rate factor which was then multiplied by the population to obtain the generation rate per week for a given geographic area. The generation factor is a function of the population density as shown in the following equations:

$$U = 1.54 \text{ Log } D - 0.68$$

$$V = U \times 7 \text{ day/week} \times 1 \text{ ton/2000 lbs.}$$

$$W = V \times \text{Population within the given area}$$

where: U = per capita waste generation rate in lbs/capita /day

D = population density in person/square miles

V = per capita waste generation rate in tons/capita/week

W = ton per week of waste generated within given area

This relationship is valid in the population density range of 500 - 12,000 persons/square mile. Below the lower limit of the range, the generation factor used is 3.4 lbs/capita/day; above the upper limit, the factor used is 5.6 lbs/capita/day.

Industrial Generation Rate

During the past few years, the Office of Solid Waste Management Programs has funded a number of industrial solid waste surveys to develop solid waste generation factors. A summary of these factors was used to develop industrial solid waste loads by SIC number. The following equation demonstrates the use of the generation factors.

$I = G.F. \times \text{No. of Employees}$

$J = I \div 52$

where I = yearly production rate in tons/year

$G.F.$ = generation factor in tons/employee/year

J = weekly production rate in tons/week

These relationships are used to estimate probable industrial waste loads, but the yearly employment fluctuation, and generation factors make adjustment necessary for specific locations and plants.

TABLE B-1

Industrial Solid Waste Generation Factors (8)

SIC No.	Name	Generation Factor (tons/employee/year)
201	Meat Products	14.1
2021	Creamery butter	33.0
2022	Cheese, Natural and Processed	169.1
202 (R)[1]	Dairy Products	2.2
203	Canned and Preserved Fruits, Vegetables and Sea Foods	5.4
204	Grain Mill Products	6.2
205	Bakery Products	1.2
206	Sugar	17.2
207	Confectionery and Related Products	3.3
208	Beverages	11.0
209	Miscellaneous Food Preparations and Kindred Products	0.8
211	Cigarettes	1.5
212	Cigars	3.1
213	Tobacco (Chewing and Smoking) and Snuff	0.2
214	Tobacco Stemming and Redrying	4.4
221	Broad Woven Fabric Mills, Cotton	0.4
222	Broad Woven Fabric Mills, Man-made Fiber and Silk	0.7
223	Broad Woven Fabric Mills	0.1
224	Narrow Fabrics and Other Small-wares Mills: Cotton, Wool, Silk and Man-made Fiber	1.2
225	Knitting Mills	1.3
226	Dyeing and Finishing Textiles, Except Wood Fabrics and Knit Goods	2.4
227	Floor Covering Mills	0.2
228	Yarn and Thread Mills	0.7
229	Miscellaneous Textile Goods	4.5
231	Men's, Youths', and Boys' Suits, Coats and Overcoats	0.3
232	Men's, Youths', and Boys' Furnishings, Work Clothing, and Allied Garments	0.3
233	Women's, Misses', and Juniors' Outerwear	0.9
234	Women's, Misses', Children's and Infants' Under Garments	0.4
235	Hats, Caps, and Millinery	0.2
236	Girls', Children's, and Infants' Outerwear	0.9
237	Fur Goods	0.5
238	Miscellaneous Apparel and Accessories	0.4
239	Miscellaneous-Fabricated Textile Products	0.4
241	Logging Camps and Logging Contractors	30.0
2421	Sawmills and planing mills, general	420.0
242 (R)[1]	Sawmills and planing mills	38.7
2432	Veneer and plywood	232.0
243 (R)[1]	Millwork, Veneer, Plywood, and Prefabricated Structural Wood Products	21.7
244	Wooden Containers	16.0
249	Miscellaneous Wood Products	43.0
251	Household Furniture	1.8
252	Office Furniture	2.6
253	Public Building and Related Furniture	1.8
254	Partitions, Shelving, Lockers, and Office and Store Fixtures	3.6
259	Miscellaneous Furniture and Fixtures	1.5
261	Pulp Mills	31.5
262	Paper Mills, Except Building Paper Mills	11.7
263	Paperboard Mills	11.5
264	Converted Paper and Paperboard Products, Except Containers and Boxes	4.0
265	Paperboard Containers and Boxes	12.6
266	Building Paper and Building Board Mills	103.0
271	Newspapers: Publishing, Publishing and Printing	1.1
272	Periodicals: Publishing, Publishing and Printing	0.1
273	Books	0.8
274	Miscellaneous Publishing	0.1
275	Commercial Printing	1.1
276	Manifold Business Forms	4.4
277	Greeting Card Publishing	1.2
278	Blankbooks, Loose Leaf Binders, and Bookbinding and Related Work	2.6
279	Service Industries for Printing Trade	1.4
2819	Industrial Inorganic Chemicals, not Elsewhere Classified	109.0
281 (R)[1]	Industrial Inorganic and Organic Chemicals	18.8
282	Plastics Materials and Synthetic Resins, Synthetic Rubber, Synthetic and Other Man-Made Fibers, Except Glass	16.2

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
283	Drugs	3.4
284	Soap, Detergents, and Cleaning Preparations, Perfumes, Cosmetics, and Other Toilet Preparations	3.3
285	Paints, Varnishes, Lacquers, Enamels, and Allied Products	6.2
286	Gum and Wood Chemicals	0.1
287	Agricultural Chemicals	13.5
2891	Adhesives and gelatin	39.4
289 (R)[1]	Miscellaneous Chemical Products	1.2
291	Petroleum Refining	30.6
295	Paving and Roofing Materials	0.9
299	Miscellaneous Products of Petroleum and Coal	9.3
301	Tires and Inner Tubes	3.7
302	Rubber Footwear	2.1
303	Reclaimed Rubber	2.4
306	Fabricated Rubber Products, Not Classified Elsewhere	2.5
307	Miscellaneous Plastics Products	1.3
311	Leather Tanning and Finishing	2.3
312	Industrial Leather Belting and Packing	0.8
313	Boot and Shoe Cut Stock and Findings	1.8
314	Footwear, Except Rubber	0.4
315	Leather Gloves and Mittens	1.3
316	Luggage	7.0
317	Handbags and Other Personal Leather Goods	0.4
319	Leather Goods, Not Elsewhere Classified	0.5
321	Flat Glass	2.5
322	Glass and Glassware, Pressed or Blown	1.4
323	Glass Products, Made of Purchased Glass	1.8
324	Cement, Hydraulic	8.8
325	Structural Clay Products	1.7
326	Pottery and Related Products	3.6
3272	Concrete products, except block and brick	154.0
327 (R)[1]	Concrete, Gypsum, and Plaster Products	15.0
328	Cut Stone and Stone Products	4.2
329	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products	5.2
3312	Blast Furnaces (including coke ovens), Steel Works, and Rolling Mills	130.0
331 (R)[1]	Blast furnaces, Steel Works, and Rolling and Finishing Mills	3.4
3321	Gray Iron foundries	100.0
332 (R)[1]	Iron and Steel Foundries	20.0
3334	Primary production of aluminum	58.0
333 (R)[1]	Primary Smelting and Refining of Nonferrous Metals	2.5
334	Secondary Smelting and Refining of Nonferrous Metals	103.0
335	Rolling, Drawing and Extruding of Nonferrous Metals	5.3
336	Nonferrous Foundries	2.7
339	Miscellaneous Primary Metal Products	2.0
341	Metal Cans	11.2
342	Cutlery, Hand Tools, and General Hardware	2.8
343	Heating Apparatus (Except Electric) and Plumbing Fixtures	7.3
344	Fabricated Structural Metal Products	2.8
345	Screw Machine Products, and Bolts, Nuts, Screws, Rivets and Washers	2.9
346	Metal Stampings	6.2
347	Coating, Engraving and Allied Services	1.5
348	Miscellaneous Fabricated Wire Products	3.1
3491	Metal Shipping Barrels, Drums, Kegs and Nails	13.7
349	Miscellaneous Fabricated Metal Products	1.4
351	Engines and Turbines	1.5
352	Farm Machinery and Equipment	0.9
353	Construction, Mining, and Materials Handling Machinery and Equipment	2.2
354	Metalworking Machinery and Equipment	2.9
355	Special Industry Machinery, Except Metalworking Machinery	0.7
356	General Industrial Machinery and Equipment	1.3
357	Office, Computing, and Accounting Machines	0.8
358	Service Industry Machines	1.5
359	Miscellaneous Machinery, Except Electrical	1.4
361	Electric Transmission and Distribution Equipment	0.8
362	Electrical Industrial Apparatus	0.7
363	Household Appliances	2.4
364	Electric Lighting and Wiring Equipment	2.2
365	Radio and Television Receiving Sets, Except Communication Types	0.8

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
366	Communication Equipment	1.9
367	Electronic Components and Accessories	1.0
369	Miscellaneous Electrical Machinery Equipment, and Supplies	2.8
371	Motor Vehicles and Motor Vehicle Equipment	2.4
372	Aircraft and Parts	1.2
3731	Ship Building and Repairing	37.0
3732	Boat Building and Repairing	4.1
374	Railroad Equipment	6.2
375	Motorcycles, Bicycles, and Parts	2.9
379	Miscellaneous Transportation Equipment	1.7
381	Engineering, Laboratory, and Scientific and Research Instruments and Associated Equipment	1.1
382	Instruments for Measuring, Controlling, and Indicating Physical Characteristics	0.4
383	Optical Instruments and Lenses	0.5
384	Surgical, Medical, and Dental Instruments and Supplies	2.3
385	Ophthalmic Goods	2.6
386	Photographic Equipment and Supplies	0.4
387	Watches, Clocks, Clockwork Operated Devices, and Parts	0.6
391	Jewelry, Silverware, and Plated Ware	0.8
393	Musical Instruments	0.6
394	Toys, Amusement, Sporting and Athletic Goods	1.7
395	Pens, Pencils, and Other Office and Artists' Materials	0.5
396	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal	0.3
399	Miscellaneous Manufacturing Industries	2.0

1) Includes the waste in the remainder of the 4-digit codes under this 3-digit code.

TABLE B-2

HAUL COST FACTORS

Type of Truck	Capacity, yd^3	Compacted Density lbs/yd^3	Cost of Truck($)	Life of Truck(yr)	Daily Operating Cost ($)	No. In Crew		Wages, $/hr.(3)				Work-Day (Hrs.)	Work-Week (Days)	Haul Cost($/ton-hr.)	
								Chicago		Downstate					
						Driver	Laborer	Driver	Laborer	Driver	Laborer			Chicago	Downstate
Rear Loading Compactor	16	500	17,175	5	40	1	1	7.19	6.56	5.70	5.10	8	5	5.10	4.36
Rear Loading Compactor (Municipal	25	500	20,772	5	35	1	2	7.19	6.56	5.70	5.10	8	5	4.28	3.66
Rear Loading Compactor (Private)	25	800	30,444	5	35	1	2	7.19	6.56	5.70	5.10	8	5	2.76	2.32
Front Loading Compactor	30	800	42,875	5	40	1	0	7.19	-	5.70	-	8	5	1.35	1.23
Tilt Frame & 13 Containers	42	500	42,325(1)	5	35	1	0	7.19	-	5.70	-	8	5	1.98	1.75
Tractor & 2 Transfer Trailers	75	500	75,800(2)	5	52	1	0	7.19	-	5.70	-	8	6	1.10	1.00*

(1) Includes the cost of the 13 containers.
(2) Includes the cost of the 2 transfer trailers.
(3) Includes fringe benefits.
* $1.40/Ton-Hr. For Vehicles operated 6 hours per day

ASSUMPTIONS FOR HAUL COST CALCULATIONS

Chicago Area

Assumptions:

1. 45% residential, 30% industrial, & 25% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 24 yd^3 compactor trucks used for residential collection.
5. Tilt-frame trucks used for industrial collection.
6. 30 yd^3 front loading compactor trucks used for commercial collection.
7. 5 loads/day by tilt-frame trucks.
8. 3 loads/day by front loading compactor trucks.

Haul Costs:

1. From collection route to intermediate facility or disposal site, collection vehicles operate 8 hours per day.
2. From intermediate facility to disposal site, vehicles operate 8 hours per day - $1.10/ton-hr.

Downstate

Assumptions:

1. 75% residential, 15% industrial, and 10% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 25 yd^3 compactor trucks used for residential collection.

5. Tilt-frame trucks used for industrial collection.

6. 30 yd^3 front loading compactor trucks used for commercial collection.

7. 5 loads/day by tilt-frame trucks.

8. 3 loads/day by front loading compactor trucks.

Haul Costs:

1. From collection route to intermediate facility or disposal site, collection trucks operate 8 hours per day.

2. From intermediate facility to disposal site where total loads are less than 150 tons/day, vehicles operate 6 hours per day - $1.40/ton-hr. For total loads greater than 150 ton/day, vehicles operate 8 hours per day - $1.00/ton-hr.

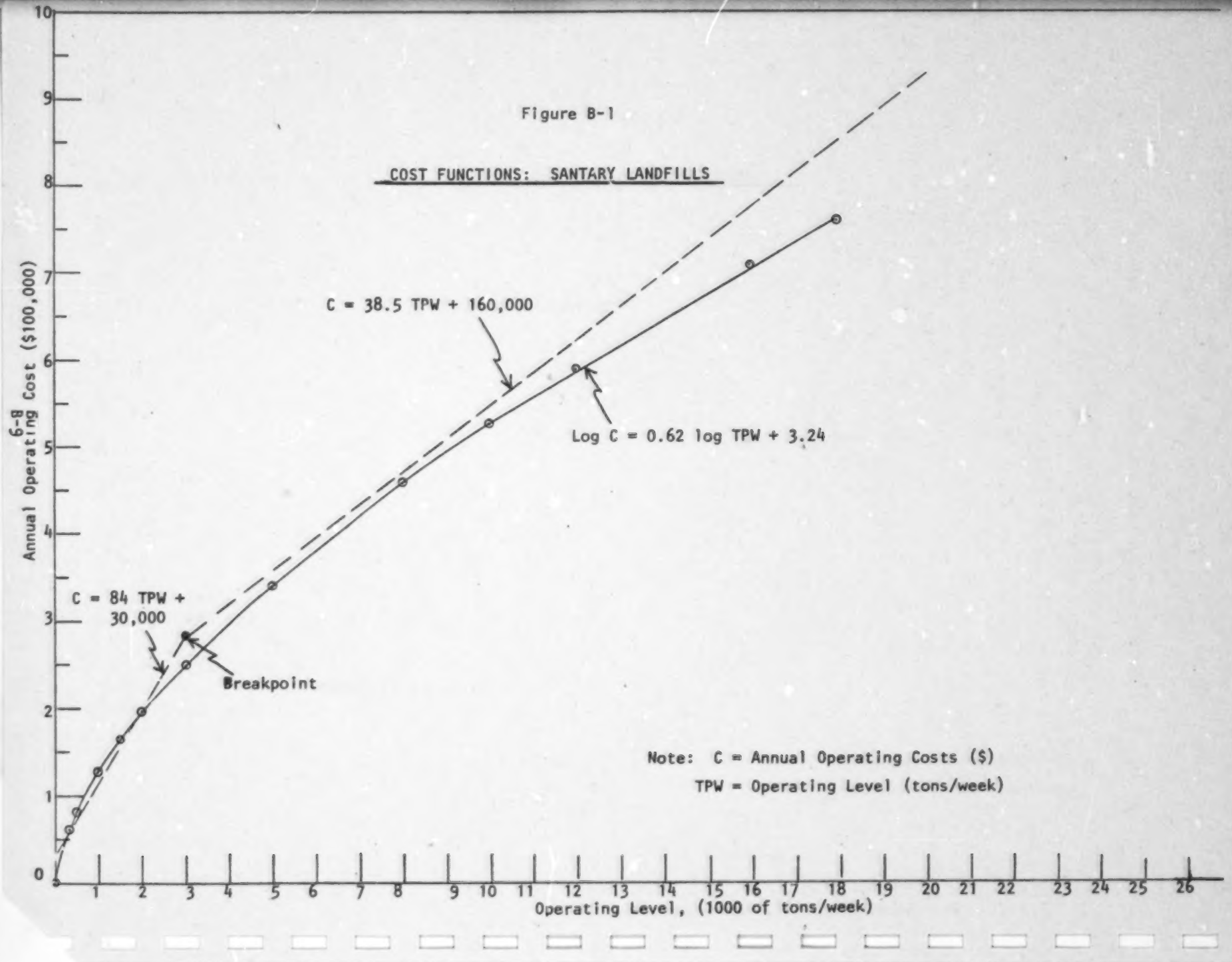


Figure B-1
COST FUNCTIONS: SANTARY LANDFILLS
C = 38.5 TPW + 160,000
Log C = 0.62 log TPW + 3.24
C = 84 TPW + 30,000
Breakpoint
Note: C = Annual Operating Costs ($)
TPW = Operating Level (tons/week)
Annual Operating Cost ($100,000)
Operating Level, (1000 of tons/week)
0 1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

BASIC LANDFILL COST ASSUMPTIONS

TABLE B-3
ASSUMING EXCAVATION DONE BY RENTED OR LEASED UNIT

50 TPW

EQUIPMENT TABLE A

Farm	CAPITAL COST		OWNING		O&M
Tractor & Loader or Blade	$15,000	@ 22%	$3,600	@24%	$3,300
Fuel	500		119		50
	$15,500		$3,719		$3,350

PERSONNEL COST-TABLE B

Supervisor & Operator @ $11.50/Hr. and fringe for 2 days a week - $184./Wk.
$9568./Per Year

FACILITY COST ESTIMATE- TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$ 9,000	8	720
2.	Preparation	25	12,000	8	840
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	$15,500		3,719
	Sub-Total		$37,500		
5.	Supervision & Inspection	25	2,510	8	201
	Sub-Total		$40,010		
6.	Contingency 10%	25	4,001	8	320
	Sub-Total		$44,011		
7.	Legal 3%	25	1,320		106
	Sub-Total		$45,331		
8.	Bond Discount 3%	25	1,360		109
	TOTAL CAPITAL COST		$46,691		6095.

ANNUAL COST	
A. Sum of 1-8	$6,095
B. Equipment	3,350
Facility CC-3 50% of	500
Miscellaneous 3% of CC-2	360
C. Salaries	9,568
Overhead	
Total Annual Cost	$19,873
Annual Cost/Ton	$ 7.64
@ 52 Weeks	
@ 50 TPW	

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-4

BASIC LANDFILL COST FUNCTION ASSUMPTIONS

100 TPW

EQUIPMENT TABLE A

	CAPITAL COST	OWNING		O&M	
Tractor & Loader or Blade	$15,000	24%	$3,600	30%	$4,500
Fuel	500		119		50
	$15,500		$3,719		$4,550

PERSONNEL COST TABLE B

Supervisor and Operator @ $11.50/Hr. include Fringe for 4 days a week - $19,136

FACILITY COST ESTIMATE TABLE C

		YR	CC	@%	AC
1.	Design	25	$10,000	8	$ 800
2.	Preparation	25	13,000	8	1,040
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	15,500		3,719
	Sub-Total		$39,500		
5.	Supervision & Inspection	25	3,020		242
	Sub-Total		$42,520		
6.	Contingency - 10%	25	4,252		340
	Sub-Total		$46,772		
7.	Legal 3%	25	1,403		112
	Sub-Total		$48,175		
8.	Bond Discount 3%	25	1,445		116
	TOTAL CAPITAL COST		$49,620		$6,449

ANNUAL COST	
A. Sum of 1-8	$ 6,449
B. Equipment	$ 4,550
Facility 50% of CC-3	500
Miscellaneous 3% of CC-2	390
C. Salaries	$19,136
Total Annual Cost	$30,975
Annual Cost/Ton @ 52 Weeks @ 100 Tons	$5.96

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-5

BASIC LANDFILL COST ASSUMPTIONS

250 TPW

EQUIPMENT TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O & M
Crawler	5	$36,000	24	$8,546	22	$8,000
Fuel	5	500	24	119		50
		$36,500		$8,665		$8,050

PERSONNEL COST TABLE B

		ANNUAL
1 Laborer $4/Hr.- 2080	Fringes	$8,320
1 Operator & Supervisor $11.50/Hr - 2080	"	24,000
		$32,320

FACILITY COST ESTIMATE TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$11,000	8	$ 880
2.	Preparation	25	14,000	8	1,120
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	36,500		8,665
	Sub-Total		$62,500		
5.	Supervision & Inspection 2% of 4	25	3,330	8	266
	Sub-Total 10% of 1-3		$65,830		
6.	Contingency 10%	25	6,583	8	527
	Sub-Total		$72,413		
7.	Legal 3%	25	2,172	8	174
	Sub-Total		$74,585		
8.	Bond 3%	25	2,238	8	179
	TOTAL CAPITAL COST		$76,823		$11,891

ANNUAL COST		
A.	Lines 1-8	$11,891
B.	Equipment	8,050
	Facility 50% of CC-3	500
	Miscellaneous 3% of CC-2	420
C.	Salaries	$32,320
	Total Annual Cost	$53,181
	Annual Cost/Unit	$ 4.13/Ton

O&M- OPERATION AND MANTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-6

BASIC LANDFILL COST ASSUMPTIONS

500 TPW

EQUIPMENT - TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O&M
Crawler 195Hp	5	$58,000	24	$13,779	24	$13,800
Fuel	5	800		190		100
Scales	10	$ 7,500	14	1,019	8	600
		$66,300		$14,988		$14,500

LABOR TABLE B

Supervisor Scale Man $4/Hr. $5/Hr.	$11,000
Operator @ $11.50 for 2080 Hr.	24,000
Laborer $4.00/Hr. for 2080 Hr.	8,320
	$4 ,320

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$15,000	8	$ 1,173
2.	Preparation	25	20,000	8	1,565
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	66,300		14,988
	Sub-Total		$109,300		
5.	Supervision & Inspection	25	5,626	8	450
	Sub-Total		$114,926		
6.	Contingency 10%	25	11,493	8	919
	Sub-Total		$126,419		
7.	Legal 3%	25	3,793	8	303
	Sub-Total		$130,212		
8.	Bond Discount 3%	25	3,906	8	312
	TOTAL CAPITAL COST		$134,118		$20,350

ANNUAL COST

A.	Line 1-8	$20,350
B.	Equipment	14,500
	Facility ≈50% of CC-3	3,500
	Miscellaneous 3% of CC-2	600
C.	Salaries	43.320
	Total Annual Cost	82,370
	Annual Unit Cost	$3.16/Ton

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-7

BASIC LANDFILL COST ASSUMPTIONS
1000 TPW

EQUIPMENT - TABLE A

	YR.	CC	%	OWNING	%	OPERATION & MAINTENANCE
1 115Hp Crawler	5	$ 36,000	24	$ 8,546	22	$ 8,000
1 170Hp Crawler	5	52,000	24	12,345	22	12,000
1 Fuel Port	5	3,000	24	712	7	200
Scales	10	10,000	14	1,359	10	1,000
		$101,000		$22,962		$21,200

PERSONNEL - TABLE B

Super & Scalemen	1	@ 2080 Hr. @ $8.17/Hr.	$17,000
Equip. Oper. 1.5	1.5	$24,000/Year	36,000
Labor	2		16,640
			$69,640

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	A.C.
1.	Design	25	$ 17,500	8	$1,369
2.	Preparation	25	25,000	8	1,956
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	101,000	-	22,962
	Sub-Total		$151,500		
5.	Supervision & Inspection	25	7,070	8	566
	Sub-Total		$158,570		
6.	Contingency 10%	25	15,857	8	1,269
	Sub-Total		$174,427		
7.	Legal 3%	25	5,233	8	418
	Sub-Total		$179,660		
8.	Bond Discount 3%	25	5,390	8	431
	TOTAL CAPITAL COST		$185,050		$29,611

ANNUAL COST	
A. Line 1-8	$29,611
B. Equipment	21,200
Facility 50% of CC-3	4,000
Miscellaneous 3% of CC-2	750
	$55,561
C. Salaries	69,640
Total Annual	$125,201
Annual Unit Cost at 962 T/W at 52 W/Yr.	$2.50/Ton

O&M- OPERATION AND MAINTENANCE
Yr,- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-8

BASIC LANDFILL COST ASSUMPTIONS

2000 TPW

EQUIPMENT TABLE A

	YR.	CAPITAL COST	%	OWNING	%	O&M
Crawler 195 Hp.	5	$ 58,000	24	$13,770	24	$13,800
Crawler 300 Hp.	5	86,000	24	20,417	22	19,000
Front End Loader 100 Hp.	5	31,000	24	7,360	19	6,000
Fuel Supply	5	5,000	24	1,187	8	400
Scale	10	11,000	14	1,495	14	1,500
		$191,000		$44,229		$40,700

PERSONNEL COSTS TABLE B

Supervisor & Scale	1 @ 2080 @ $8.2/Hr.	$17,056
Laborer	2 @ 2080 @ $4./Hr.	16,640
Equip. Operator	2.5 @ $11.50/Hr and 2080 Hrs.	59,800
		$93,496

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$20,000	8	$ 1,565
2.	Site Preparation	25	30,000	8	2,347
3.	Building Facilities	25	21,620	8	1,691
4.	Equipment	Varies	191,000	-	44,229
	Sub-Total		$262,620		
5.	Supervision & Inspection	25	10,982	8	879
	Sub-Total		$273,602		
6.	Contingency - 10%	25	27,360	8	2,189
	Sub-Total		$300,962		
7.	Legal 3%	25	9,029	8	722
	Sub-Total		$309,991		
8.	Bond Discount 3%	25	9,299	8	744
	TOTAL CAPITAL COST		$319,290		$54,366

ANNUAL COST	
A. Lines 1-8	$54,366
B. Equipment	40,700
Facility 50% of CC-3	10,810
Miscellaneous 3% of CC-2	900
C. Salaries	93,496
Total Annual Cost	$200,272
Annual Unit Cost	$2.00/Ton

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC- ANNUAL CAPITAL RECOVERY VALUE

Table B-9

BASIC LANDFILL COST ASSUMPTIONS

5000 TPW

EQUIPMENT TABLE A

NO.	YR.	CAPITAL COST	%	OWNING	%	O&M
1. Crawler 195Hp.	5	$ 58,000		$13,770		$13,800
2. Crawler 300Hp.	5	86,000		20,417		19,000
170Hp.	5	52,000		12,345		12,000
1. Loader 300Hp.	5	31,000		7,360		6,000
1. Scraper 150Hp.	5	49,000		11,633		18,000
1. Truck Pick-Up	4	4,000	29	1,160	46	1,840
1. Fuel Truck	5	13,000	24	3,086	35	4,500
1. Water Tank Truck	5	12,000	24	2,849	35	4,000
Motor Grador	5	31,000	24	7,360	13	4,000
Scale	10	25,000		3,397		3,000
		$361,000		$83,377		$86,140

PERSONNEL COSTS TABLE B

5 Operators @ $11.50/Hr. @2080	$120,000	
4 Laborer $4.00/Hr.	33,280	
2 Scale Operator @ $11066./Year	22,132	Based on Ratio of Lab/Sc.Op.
1 Supervisor @ $17,000 @ $8.2/Hr.	17,000	Based on Ratic of Sc. Op/Sup.

FACILITY COST ESTIMATE TABLE C

	YR.	CC	@%	AC
1. Design	25	$ 25,000	8	$ 1,956
2. Preparation	25	40,000	8	3,129
3. Building Facilities	25	27,244	8	2,131
4. Equipment	Varies	361,000	-	83,377
Sub-Total		$453,244		
5. Supervision & Inspection	25	16,444		1,316
Sub-Total		469,688		
6. Contingency 10%	25	46,969		3,758
Sub-Total		$516,657		
7. Legal 3%	25	15,500		1,240
Sub-Total		$532,157		
8. Bond Discount 3%	25	15,965		1,277
		$548,122		$98,184

O&M - OPERATION AND MAINTENANCE
Yr. - NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST

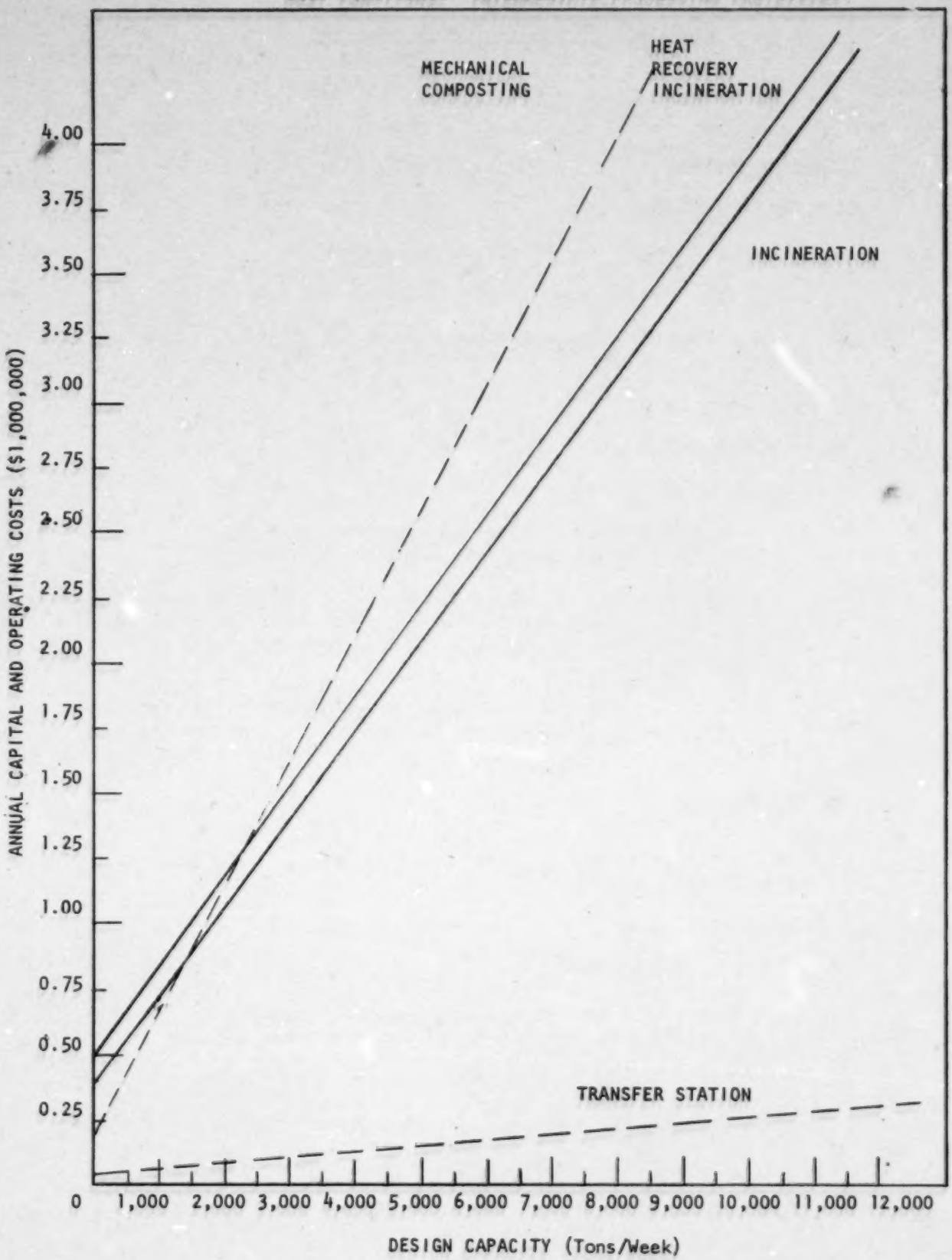
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-9 Continued

A.	Sum 1-8	$98,184
B.	Equipment	86,140
	Facility	13,622
	50% of CC - 3 Miscellaneous	1,200
C.	3% of CC - 2 Salaries	$192,412
	Annual Cost	$391,558
	Annual Unit Cost	$1.50/Ton

Figure B-2

COST FUNCTIONS: INTERMEDIATE PROCESSING FACILITIES



EQUATIONS FOR FACILITY COST FUNCTIONS

Transfer Station

$C = 22\ TPW + 40{,}000$

Where C = Annual capital and operating cost ($)

TPW = Design capacity of facility (tons/week)

NOTE: Does not include transport costs.

Compost Plant

Mechanical Digestion:

$C = 500\ TPW + 200{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Cost of residue disposal not included. Approximately 15% of solid waste input must be disposed of when salvage is not practiced; 5% when salvage is practiced.

2) No credit is given for sale of the end product or the salvaged materials. Approximately 33% of the input quantity emerges as compost, and glass and ferrous salvage usually amount to 5% each of the input quantity.

Incinerator

Standard:

$C = 320\ TPW + 400{,}000$

With Power Production

$C = 340\ TPW + 500{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Continuous - feed furnaces

2) Air pollution control equipment included

3) No credit is given for the sale of power

Sanitary Landfill

Capital Cost: Consultant's estimate for each individual case.

Operating Cost:

$C = 84\ TPW + 30,000$ when $TPW \leq 3,000$
$C = 38.5\ TPW + 160,000$ when $TPW > 3,000$

Where C = Annual operating cost ($)
TPW = Operating level (tons/week)

The curve that best fit the cost data is described by the following equation:

$$C = 0.62 \log TPW + 3.24$$

Since only linear equations are acceptable to the optimization routine, two linear equations were fitted to the curve aroung the specified breakpoint which yielded the two linear equations above.

RESOURCE RECOVERY FACILITY AND COST

The following system was designed to process up to 750 tons per day of municipal solid waste based upon a 2-shift operation. The system will shred all waste, magnetically separate ferrous metals and separate heavy and light fractions. Two shredders are provided to assure continuous service. The system will produce: shredded fuel, ferrous metals, and a mixture of glass and non-ferrous metals.

This estimate does not include the power plant handling and transportation costs. Included in the building cost is a pile foundation.

This system was designed in 1973 for the City of New Orleans by the National Center for Resource Recovery, but has not been constructed. The construction and operating costs included herein are unvarified estimates of cost.

TABLE B-10

FACILITY (750 Tons/Day, 2 Shift)

	MATERIALS	LABOR
Scale	57,375	6,715
Front End Loader	58,300	-
Municipal Solid Waste Conveyor System	201,235	14,740
Reject Bin (large objects)	6,985	-
Trommel Screen	143,185	11,120
Trommel Discharge Conveyor	12,445	19,085
Shredder Feed Conveyor	20,005	19,085
Shredder (2)	569,615	18,790
Shredder Discharge Conveyor	45,545	805
Air Classifier	270,960	42,190
Magnetic Separator	28,000	7,000
By-pass Conveyor	25,380	2,115
Shredder Materials Conveyor System	58,235	2,115
Heavy Materials Conveyor System	25,875	4,935
Electrical System	51,650	10,075
	$1,574,890	$158,770
Building, Receiving (1,000 Ton Storage)	182,880	14,590
Asphalt Apron	14,750	12,010
Shredder Building	113,305	79,500
	$ 310,935	$106,100
Engineering, Contingencies, Profit	510,385	
Total Cost	$2,661,080	

TABLE B-10 (Continued)

OPERATING COST

Amortization (10 Years @ 8%)

2,661,080 (CRF 10 Years @ 8%) 0.149 ÷ 12 =	45,500
Power, water	14,538
Shredding	23,469
Recovery	28,608
Cost per Month	$112,015

Total Annual Cost $1,340,000

750 Tons/Day x 6 Day/Week x 52 Weeks/year = 234,000 Tons/Year

Cost per Ton = $5.73

@ 500 Tons/Day x 312 Days/Year = 156,000 Tons

Cost Per Ton = $8.60